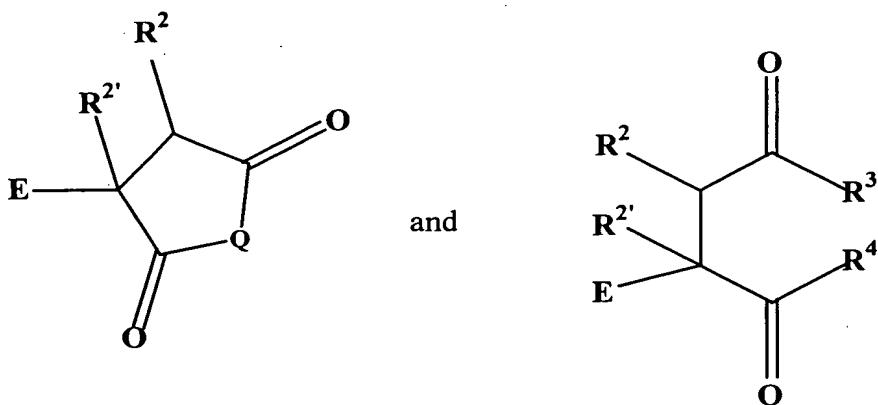


CLAIMS

We claim:

1. A nanocomposite comprising clay and an elastomer comprising C₂ to C₁₀ olefin derived units; wherein the elastomer also comprises functionalized monomer units having functional groups pendant to the elastomer, E, selected from the following:



wherein Q is selected from O and an NR¹ group, wherein R¹ is selected from hydrogen, C₁ to C₂₀ alkyls, alkenyls or aryls, substituted C₁ to C₂₀ alkyls, alkenyls or aryls; R² and R^{2'} are the same or different and are selected from hydrogen, C₁ to C₂₀ alkyls, alkenyls or aryls, hydroxyl and C₁ to C₂₀ alkoxys; and wherein R³ and R⁴ are the same or different and selected from -OR⁵ and -NHR⁵, wherein R⁵ is defined as R¹ above.

2. The nanocomposite of Claim 1, wherein the elastomer also comprises monomer units selected from styrenic derived units and substituted styrenic derived units.

3. The nanocomposite of Claim 2, wherein the styrenic units are functionalized.

4. The nanocomposite of Claim 1, wherein the elastomer is not halogenated.

5. The nanocomposite of Claim 1, wherein the olefin is selected from one or more of isobutylene, isobutene, 2-methyl-1-butene, 3-methyl-1-butene, 2-methyl-2-butene, and 4-methyl-1-pentene, ethylene, propene, 1-butene, 1-hexene, and 1-octene.

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6. The nanocomposite of Claim 2, wherein the styrene derived units are present from 1 to 15 wt% of the elastomer.

7. The nanocomposite of Claim 1, wherein the elastomer comprises *p*-methylstyrene derived units.

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8. The nanocomposite of Claim 1, wherein the elastomer also comprises isoolefin derived units and *p*-methylstyrene derived units.

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9. The nanocomposite of Claim 1, wherein the elastomer is selected from natural rubber, poly(isobutylene-*co*-isoprene), polybutadiene, poly(styrene-*co*-butadiene) rubber, poly(isoprene-*co*-butadiene), poly(styrene-isoprene-butadiene), star-branched polyisobutylene rubber, poly(isobutylene-*co*-*p*-methylstyrene), and mixtures thereof.

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10. The nanocomposite of Claim 1, wherein the functionalized units are present on the elastomer from 0.01 wt% to 15 wt% of the elastomer.

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11. The nanocomposite of Claim 1, wherein the clay has been treated with an exfoliating agent to form an exfoliated clay.

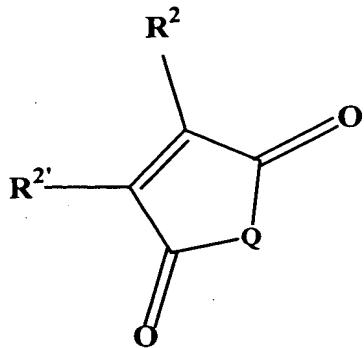
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12. The nanocomposite of Claim 11, wherein the exfoliating agent is selected from ammonium ion, alkylamines, alkylammonium ion (primary, secondary, tertiary and quaternary), phosphonium or sulfonium derivatives of aliphatic, aromatic or arylaliphatic amines, phosphines and sulfides and blends thereof.

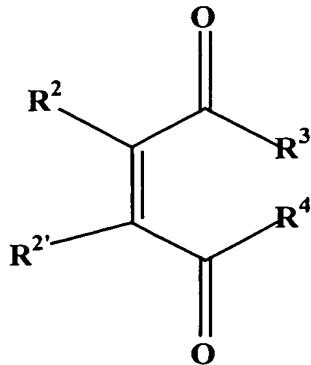
13. The nanocomposite of Claim 1, wherein the clay is present from 0.1 wt% to 50 wt% of the nanocomposite.
14. The nanocomposite of Claim 1, wherein the clay is present from 0.2 wt% to 10 wt% of the nanocomposite.
15. The nanocomposite of Claim 1, wherein the clay is present from 1 wt% to 30 wt% of the nanocomposite.
- 10 16. The nanocomposite of Claim 1, also comprising a filler selected from carbon black, modified carbon black, silica, precipitated silica, and blends thereof.
- 15 17. The nanocomposite of Claim 1, also comprising curing agents.
18. The nanocomposite of Claim 17, wherein the curing agents comprise zinc, zinc stearate, fatty acids, sulfur, diamine and diamine derivatives, and mixtures thereof.
- 20 19. The nanocomposite of Claim 1, also comprising a secondary rubber selected from natural rubber, polybutadiene rubber, nitrile rubber, silicon rubber, polyisoprene rubber, poly(styrene-*co*-butadiene) rubber, poly(isoprene-*co*-butadiene) rubber, styrene-isoprene-butadiene rubber, ethylene-propylene rubber, brominated butyl rubber, chlorinated butyl rubber, halogenated isoprene, halogenated isobutylene copolymers, polychloroprene, star-branched polyisobutylene rubber, star-branched brominated butyl rubber, poly(isobutylene-*co*-isoprene) rubber; halogenated poly(isobutylene-*co*-*p*-methylstyrene), ethylene-propylene rubber and mixtures thereof.
- 30 20. A tire innerliner comprising the nanocomposite of Claim 1.

21. An innertube comprising the nanocomposite of Claim 1.
22. A method of forming a nanocomposite comprising contacting:
 - 5 (a) an elastomer, wherein the elastomer comprises C₂ to C₁₀ olefin derived units;
 - 10 (b) at least one functionalizing compound selected from unsaturated acid anhydrides, unsaturated esters, unsaturated imides, and mixtures thereof;
 - (c) at least one free radical initiator; and
 - 15 (d) clay.
23. The method of Claim 22, wherein the elastomer is first contacted with the functionalizing compound, followed by contacting with the clay.
24. The method of Claim 22, wherein the elastomer, clay and functionalizing compound are contacted simultaneously.
- 20 25. The method of Claim 23 or 24, wherein the elastomer and functionalizing compound are solubilized in a diluent.
26. The method of Claim 22, wherein the elastomer and functionalizing compound are melt blended.
27. The method of Claim 22, wherein the free radical initiator is a peroxide selected from diacyl peroxides, ketone peroxides, peroxyesters, peroxydicarbonates, dialkyl peroxides, hydroperoxides, peroxyketals.

28. The method of Claim 22, wherein the functionalizing compound is selected from:



and



wherein Q is selected from O and an NR¹ group, wherein R¹ is selected from hydrogen, C₁ to C₂₀ alkyls, alkenyls or aryls, substituted C₁ to C₂₀ alkyls, alkenyls or aryls; R² and R^{2'} are the same or different and are selected from hydrogen, C₁ to C₂₀ alkyls, alkenyls or aryls, hydroxyl and C₁ to C₂₀ alkoxy; and wherein R³ and R⁴ are the same or different and are selected from -OR⁵ and -NHR⁵, wherein R⁵ is defined as R¹ above.

29. The method of Claim 22, wherein the functionalizing compound is selected from monomethyl maleate, dimethyl maleate, diethyl maleate, diphenyl maleate, dibutyl fumarate, maleimide, citraconic anhydride, itaconic anhydride, maleic anhydride, N,N'-phenylenedimaleimide, N-methylmaleimide, N-phenylmaleimide, maleic acid, itaconic acid, and the metal carboxylic derivatives thereof.

30. The method of Claim 22, wherein the elastomer also comprises monomer units selected from styrenic derived units and substituted styrenic derived units.

31. The method of Claim 22, wherein the olefin is selected from one or more of isobutylene, isobutene, isoprene, cyclopentadiene, 2-methyl-1-butene, 3-methyl-1-butene, 2-methyl-2-butene, and 4-methyl-1-pentene, ethylene, propene, 1-butene, 1-hexene, and 1-octene.
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32. The method of Claim 30, wherein the styrene derived units are present from 1 to 15 wt% of the elastomer.
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33. The method of Claim 22, wherein the elastomer comprises *p*-methylstyrene derived units.
34. The method of Claim 22, wherein the elastomer also comprises isoolefin derived units and *p*-methylstyrene derived units.
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35. The method of Claim 22, wherein the elastomer is selected from natural rubber, poly(isobutylene-*co*-isoprene), polybutadiene, poly(styrene-*co*-butadiene) rubber, poly(isoprene-*co*-butadiene), poly(styrene-isoprene-butadiene), star-branched polyisobutylene rubber, poly(isobutylene-*co*-styrene), poly(isobutylene-*co*-*p*-methylstyrene), ethylene-propylene rubber and mixtures thereof.
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36. The method of Claim 22, wherein the elastomer is functionalized by contacting with the functionalizing compound, wherein the functional groups are present on the elastomer from 0.01 wt% to 15 wt% of the elastomer.
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37. The method of Claim 22, wherein the clay has been treated with an exfoliating agent to form an exfoliated clay.
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38. The method of Claim 37, wherein the exfoliating agent is selected from ammonium ion, alkylamines, alkylammonium ion (primary, secondary, tertiary and quaternary), phosphonium or sulfonium derivatives of

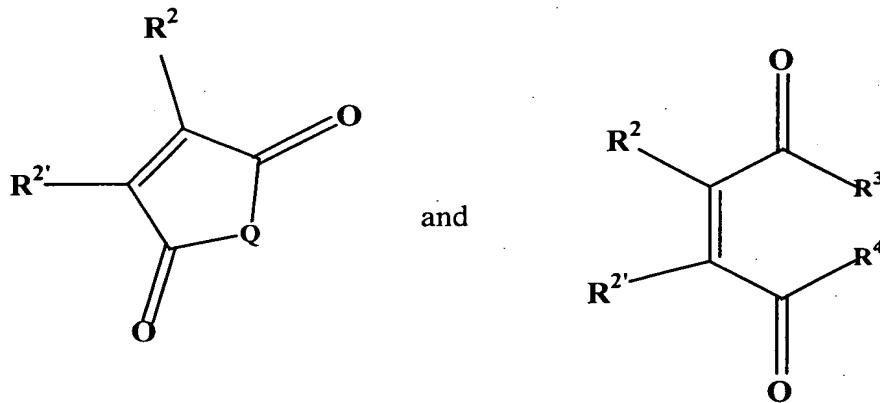
aliphatic, aromatic or arylaliphatic amines, phosphines and sulfides and blends thereof.

39. The method of Claim 22, wherein the clay is present from 0.1 wt% to 50 wt% of the nanocomposite.
40. The method of Claim 22, wherein the clay is present from 0.2 wt% to 10 wt% of the nanocomposite.
- 10 41. The method of Claim 22, wherein the clay is present from 1 wt% to 30 wt% of the nanocomposite.
42. The method of Claim 22, also comprising a filler selected from carbon black, modified carbon black, silica, precipitated silica, and blends thereof.
- 15 43. The method of Claim 22, also comprising curing agents.
44. The method of Claim 43, wherein the curing agents comprise zinc, zinc stearate, fatty acids, sulfur, diamine and diamine derivatives and mixtures thereof.
- 20 45. The method of Claim 22, also comprising a secondary rubber selected from natural rubber, polybutadiene rubber, nitrile rubber, silicon rubber, polyisoprene rubber, poly(styrene-*co*-butadiene) rubber, poly(isoprene-*co*-butadiene) rubber, styrene-isoprene-butadiene rubber, ethylene-propylene rubber, brominated butyl rubber, chlorinated butyl rubber, halogenated isoprene, halogenated isobutylene copolymers, polychloroprene, star-branched polyisobutylene rubber, star-branched brominated butyl rubber, poly(isobutylene-*co*-isoprene) rubber; halogenated poly(isobutylene-*co*-*p*-methylstyrene) and mixtures thereof.
- 25 30 46. A tire innerliner made by the method of Claim 22.

47. An innertube made by the method of Claim 22.

48. A nanocomposite comprising clay and the reaction product of contacting
5 an elastomer comprising C₂ to C₁₀ olefin derived units with at least one free radical initiator, and a functionalizing compound selected from unsaturated acid anhydrides, unsaturated esters, unsaturated imides, and mixtures thereof.

10 49. The nanocomposite of Claim 48, wherein the functionalizing compound is selected from:



15 wherein Q is selected from O and an NR¹ group, wherein R¹ is selected
from hydrogen, C₁ to C₂₀ alkyls, alkenyls or aryls, substituted C₁ to C₂₀ alkyls, alkenyls or aryls; R² and R^{2'} are the same or different and are selected from hydrogen, C₁ to C₂₀ alkyls, alkenyls or aryls, substituted C₁ to C₂₀ alkyls, alkenyls or aryls, hydroxyl and C₁ to C₂₀ alkoxy; and wherein R³ and R⁴ are the same or different and are selected from -OR⁵ and -NHR⁵, wherein R⁵ is defined as R¹ above.
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50. The nanocomposite of Claim 48, wherein the functionalizing compound is selected from monomethyl maleate, dimethyl maleate, diethyl maleate, diphenyl maleate, dibutyl fumarate, maleimide, citraconic anhydride,

itaconic anhydride, maleic anhydride, N,N'-phenylenedimaleimide, N-methylmaleimide, N-phenylmaleimide, maleic acid, itaconic acid, and the metal carboxylic derivatives thereof.

- 5 51. The nanocomposite of Claim 48, wherein the free radical initiator is a peroxide selected from wherein the peroxide is selected from diacyl peroxides, ketone peroxides, peroxyesters, peroxydicarbonates, dialkyl peroxides, hydroperoxides, peroxyketals.
- 10 52. The nanocomposite of Claim 48, wherein the elastomer also comprises monomer units selected from styrenic derived units and substituted styrenic derived units.
- 15 53. The nanocomposite of Claim 52, wherein the styrenic units are functionalized.
54. The nanocomposite of Claim 48, wherein the elastomer is not halogenated.
- 20 55. The nanocomposite of Claim 48, wherein the olefin is selected from one or more of isobutylene, isobutene, isoprene, cyclopentadiene, 2-methyl-1-butene, 3-methyl-1-butene, 2-methyl-2-butene, and 4-methyl-1-pentene, ethylene, propene, 1-butene, 1-hexene, and 1-octene.
- 25 56. The nanocomposite of Claim 52, wherein the styrene derived units are present from 1 to 15 wt% of the elastomer.
57. The nanocomposite of Claim 48, wherein the elastomer comprises *p*-methylstyrene derived units.
- 30 58. The nanocomposite of Claim 48, wherein the elastomer also comprises isoolefin derived units and *p*-methylstyrene derived units.

59. The nanocomposite of Claim 48, wherein the elastomer is selected from natural rubber, poly(isobutylene-*co*-isoprene), polybutadiene, poly(styrene-*co*-butadiene) rubber, poly(isoprene-*co*-butadiene), poly(styrene-isoprene-butadiene), star-branched polyisobutylene rubber, 5 poly(isobutylene-*co*-styrene), poly(isobutylene-*co*-*p*-alkylstyrene) and mixtures thereof.
- 10 60. The nanocomposite of Claim 48, wherein the functionalized units are present on the elastomer from 0.01 wt% to 15 wt% of the elastomer.
- 10 61. The nanocomposite of Claim 48, wherein the clay has been treated with an exfoliating agent to form an exfoliated clay.
- 15 62. The nanocomposite of Claim 61, wherein the exfoliating agent is selected from ammonium ion, alkylamines, alkylammonium ion (primary, secondary, tertiary and quaternary), phosphonium or sulfonium derivatives of aliphatic, aromatic or arylaliphatic amines, phosphines and sulfides and blends thereof.
- 20 63. The nanocomposite of Claim 48, wherein the clay is present from 0.1 wt% to 50 wt% of the nanocomposite.
64. The nanocomposite of Claim 48, wherein the clay is present from 0.2 wt% to 10 wt% of the nanocomposite.
- 25 65. The nanocomposite of Claim 48, wherein the clay is present from 1 wt% to 30 wt% of the nanocomposite.
- 30 66. The nanocomposite of Claim 48, also comprising a filler selected from carbon black, modified carbon black, silica, precipitated silica, and blends thereof.

67. The nanocomposite of Claim 48, also comprising curing agents.
68. The nanocomposite of Claim 67, wherein the curing agents comprise zinc, zinc stearate, fatty acids, sulfur, diamine and diamine derivatives and mixtures thereof.
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69. The nanocomposite of Claim 48, also comprising a secondary rubber selected from natural rubber, polybutadiene rubber, nitrile rubber, silicon rubber, polyisoprene rubber, poly(styrene-*co*-butadiene) rubber, poly(isoprene-*co*-butadiene) rubber, styrene-isoprene-butadiene rubber, ethylene-propylene rubber, brominated butyl rubber, chlorinated butyl rubber, halogenated isoprene, halogenated isobutylene copolymers, polychloroprene, star-branched polyisobutylene rubber, star-branched brominated butyl rubber, poly(isobutylene-*co*-isoprene) rubber; 10
15 halogenated poly(isobutylene-*co*-*p*-methylstyrene) and mixtures thereof.
70. A tire innerliner comprising the nanocomposite of Claim 48.
71. An innertube comprising the nanocomposite of Claim 48.
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